



Effect of electromagnetic radiation from cell phone usage on various human systems.

Description

N.B. Similar arguments apply to **smart*meters, WiFi, wireless headphones, etc. pp.* (5G is a very different, much bigger animal).

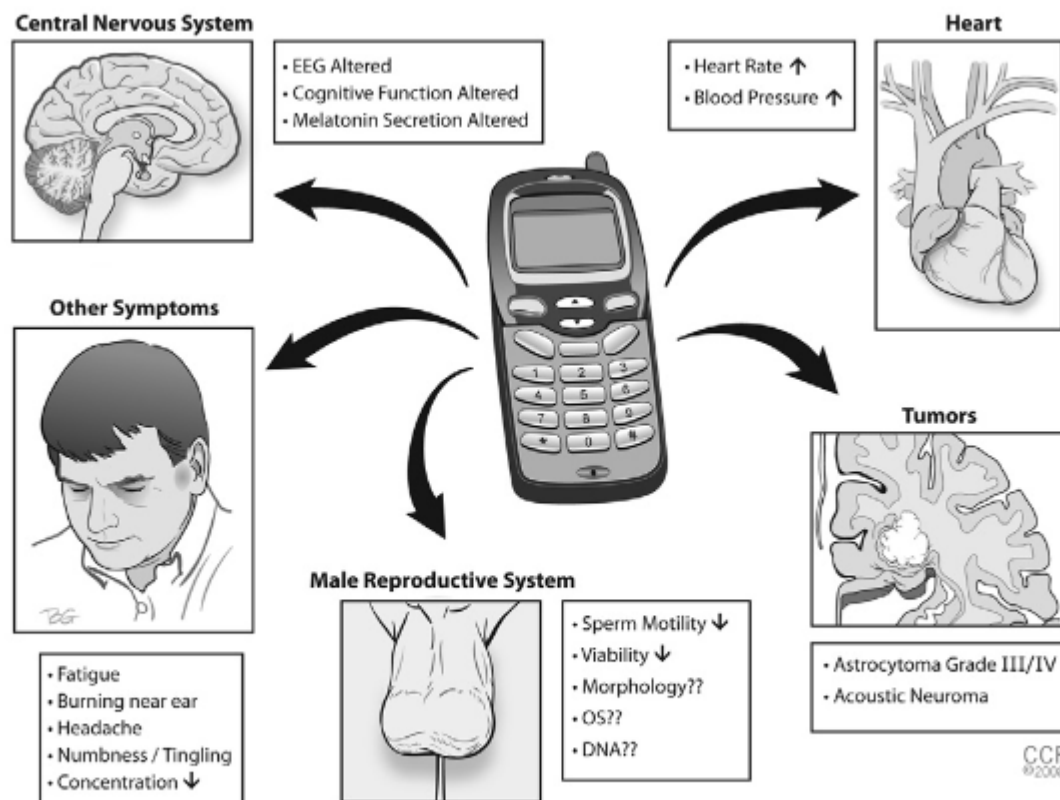


Figure 1. Effect of electromagnetic radiation from cell phone usage on various human systems. OS = oxidative stress.

Image source: Makker, K., Varghese, A., Desai, N. R., Mouradi, R., & Agarwal, A. (2009). Cell phones: Modern man's nemesis? *Reproductive BioMedicine Online*. [doi.org/10.1016/S1472-6483\(10\)60437-3](https://doi.org/10.1016/S1472-6483(10)60437-3)

The conscious electromagnetic information (cemi) field theory
McFadden, J. (2020). Integrating information in the brain's EM field: the cemi field theory of consciousness. *Neuroscience of Consciousness*. doi.org/10.1093/nc/niaa016

"The conscious electromagnetic information (cemi) field theory claims that the brain's EM field is the physical substrate of consciousness. It was first outlined in a book published in 2000 in which I proposed that the brain's 'EM field...integrate[s] information from all of the calculations...performed by...[its] logicgates (McFadden 2000). The theory was further developed into two papers published in



2002 (McFadden2002a,b). Similar theories were proposed around the same time by neurobiologist Pockett (2000,2002), the neurophysiologist John (2001,2002) and the neurophysiologists Fingelkurts and Fingelkurts (2008) and Fingelkurts et al. (2001)."

Source URL: academic.oup.com/nc/article/2020/1/niaa016/5909853

Further references:

McFadden, J. (2020). Integrating information in the brain's EM field: the cemi field theory of consciousness. *Neuroscience of Consciousness*. doi.org/10.1093/nc/niaa016

McFadden, J. (2002). Synchronous Firing and Its Electromagnetic Field. *Journal of Consciousness Studies*.

McFadden, J. (2007). Conscious electromagnetic field theory. *NeuroQuantology*. doi.org/10.14704/nq.2007.5.3.135

McFadden, J. (2013). The CEMI field theory: Closing the loop. *Journal of Consciousness Studies*.

McFadden, J. (2013). The CEMI Field Theory. *Journal of Consciousness Studies*.

McFadden, J. (2002). Synchronous Firing and Its Influence on the Brain's Electromagnetic Field Evidence for an Electromagnetic Field Theory of Consciousness. *Journal of Consciousness Studies*.

McFadden, J. (2002). Synchronous firing and its influence on the brain's electromagnetic field. *Journal of Consciousness Studies*.

McFadden, J. (2013). The CEMI field theory: Gestalt information and the meaning of meaning. *Journal of Consciousness Studies*.

McFadden, J. (2013). EM fields and the meaning of meaning response to Jonathan C.W. Edwards. *Journal of Consciousness Studies*.

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Protect yourself (and your kids): showthefineprint.org/protect-yourself

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"The truth about mobile phone and wireless radiation" lecture by [Dr. Devra Davis](#)

The University of Melbourne

See associated case @ U.S. Court of Appeals for the District of Columbia

[20-1025-1910111](#)

Study excerpt

In May 2011 the International Agency for Research on Cancer (IARC) evaluated cancer risks from radiofrequency (RF) radiation. Epidemiological studies provided supportive evidence of increased risk for head and brain tumours, i.e., acoustic neuroma and glioma. The working group reached the conclusion that RF radiation from devices that emit non-ionizing RF radiation in the frequency range 30 kHz-300 GHz, is a Group 2B, i.e. a 'possible', human carcinogen (3,4). Later studies have corroborated these findings and have thus strengthened the evidence (5-8). ... Several laboratory studies have indicated mechanisms of action for RF radiation carcinogenesis such as on DNA repair, oxidative stress, down regulation of mRNA and DNA damage with single strand breaks (9-13). A report was released from The National Toxicology Program (NTP) under the National Institutes of Health (NIH) in USA on the largest ever animal study on cell phone RF radiation and cancer (14). An increased incidence of glioma in the brain and malignant



schwannoma in the heart was found in rats. Acoustic neuroma or vestibular schwannoma is a similar type of tumour as the one found in the heart, although benign. Thus, this animal study supported human epidemiological findings on RF radiation and brain tumour risk (8).

Source: www.ncbi.nlm.nih.gov/pmc/articles/PMC5504984/

Smart Meter Documentary - Take Back Your Power 2017

Naval Medical Research Institute Report on biological phenomena associated with microwave and radio-frequency radiation (published in 1971)

[Navy_Radiowave_Brief_1_1](#)

Cell Phone 'Poisoning' - A synopsis

[Cell_Phone_Poisoning_Of_America](#)

www.5gappeal.eu

Hardell, L., & Nyberg, R. (2020). Appeals that matter or not on a moratorium on the deployment of the fifth generation, 5G, for microwave radiation. *Molecular and clinical oncology*, 12(3), 247–257.

doi.org/10.3892/mco.2020.1984

Nyberg, N. R., McCredde, J. E., Weller, S. G., & Hardell, L. (2022). The European Union prioritises economics over health in the rollout of radiofrequency technologies. *Reviews on Environmental Health*.

doi.org/10.1515/reveh-2022-0106

Abstract

“The fifth generation of radiofrequency communication, 5G, is currently being rolled out worldwide. Since September 2017, the EU 5G Appeal has been sent six times to the EU, requesting a moratorium on the rollout of 5G. This article reviews the 5G Appeal and the EU’s subsequent replies, including the extensive cover letter sent to the EU in September 2021, requesting stricter guidelines for exposures to radiofrequency radiation (RFR). The Appeal notes the EU’s internal conflict between its approach to a wireless technology-led future, and the need to protect the health and safety of its citizens. It critiques the reliance of the EU on the current guidelines given by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), that consider only heating and no other health relevant biological effects from RFR. To counteract the ICNIRP position, the 2021 cover letter briefly presented recent research from the EU’s own expert groups, from a large collection of European and other international studies, and from previous reviews of the effects of RFR on humans and the environment. The 5G Appeal asserts that the majority of scientific evidence points to biological effects, many with the potential for harm, occurring below the ICNIRP public limits. Evidence to establish this position is drawn from studies showing changes to neurotransmitters and receptors, damage to cells, proteins, DNA, sperm, the immune system, and human health, including cancer. The 2021 Appeal goes on to warn that 5G signals are likely to additionally alter the behaviour of oxygen and water molecules at the quantum level, unfold proteins, damage skin, and cause harm to insects, birds, frogs, plants and animals. Altogether, this evidence establishes a high priority for the European Union towards (i) replacing the current flawed guidelines with protective thresholds, and (ii) placing a moratorium on 5G deployment so as to (iii) allow industry-independent scientists the time needed to propose new health-protective guidelines. This 2021 Appeal’s relevance becomes even more pressing in the context of the EU plans to roll out the sixth generation of wireless technologies, 6G, further adding to the known risks



of RFR technology for humans and the environment. This all leads to an important question: Do EU decision makers have the right to ignore EÚs own directives by prioritising economic gain over human and environmental health?"

Source URL: research.abo.fi/en/publications/the-european-union-prioritises-economics-over-health-in-the-rollo

See also EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 690.012 – July 2021
[EPRS_STU\(2021\)690012_EN](https://eprs-stu(2021)690012_en)

Further References

Makker, K., Varghese, A., Desai, N. R., Mouradi, R., & Agarwal, A.. (2009). Cell phones: Modern man's nemesis?. Reproductive BioMedicine Online

Plain numerical DOI: 10.1016/S1472-6483(10)60437-3
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"Over the past decade, the use of mobile phones has increased significantly. however, with every technological development comes some element of health concern, and cell phones are no exception. recently, various studies have highlighted the negative effects of cell phone exposure on human health, and concerns about possible hazards related to cell phone exposure have been growing. this is a comprehensive, up-to-the-minute overview of the effects of cell phone exposure on human health. the types of cell phones and cell phone technologies currently used in the world are discussed in an attempt to improve the understanding of the technical aspects, including the effect of cell phone exposure on the cardiovascular system, sleep and cognitive function, as well as localized and general adverse effects, genotoxicity potential, neurohormonal secretion and tumour induction. the proposed mechanisms by which cell phones adversely affect various aspects of human health, and male fertility in particular, are explained, and the emerging molecular techniques and approaches for elucidating the effects of mobile phone radiation on cellular physiology using high-throughput screening techniques, such as metabolomics and microarrays, are discussed. a novel study is described, which is looking at changes in semen parameters, oxidative stress markers and sperm dna damage in semen samples exposed in vitro to cell phone radiation. © 2009 published by reproductive healthcare ltd."

Nittby, H., Grafström, G., Tian, D. P., Malmgren, L., Brun, A., Persson, B. R. R., ... Eberhardt, J.. (2008). Cognitive impairment in rats after long-term exposure to GSM-900 mobile phone radiation. Bioelectromagnetics

Plain numerical DOI: 10.1002/bem.20386
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"Considering the frequent use of mobile phones, we have directed attention to possible implications on cognitive functions. In this study we investigated in a rat model the long-term effects of protracted exposure to global system for mobile communication-900 mhz (gsm-900) radiation. Out of a total of 56 rats, 32 were exposed for 2 h each week for 55 weeks to radio-frequency electromagnetic radiation at different SAR levels (0.6 and 60 mW/kg at the initiation of the experimental period) emitted by a (gsm-900) test phone. Sixteen animals were sham exposed and eight animals were cage controls, which never left the animal house. After this protracted exposure, gsm-900 exposed rats were compared to sham exposed controls. Effects on exploratory behaviour were evaluated in the open-field test, in which no difference was seen. Effects on cognitive functions were evaluated in the episodic-like memory test. In our study, gsm exposed rats had impaired memory for objects and their temporal order of presentation, compared to sham exposed controls ($p = 0.02$). Detecting the place in which an object was presented was not affected by gsm exposure. Our results suggest significantly reduced memory functions in rats after gsm microwave exposure ($p = 0.02$)."

Megha, K., Deshmukh, P. S., Banerjee, B. D., Tripathi, A. K., & Abegaonkar, M. P.. (2012).

Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats. *Indian Journal of Experimental Biology*

Plain numerical DOI: 10.1109/GSIS.2011.6044119

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"Public concerns over possible adverse effects of microwave radiation emitted by mobile phones on health are increasing. To evaluate the intensity of oxidative stress, cognitive impairment and inflammation in brain of Fischer rats exposed to microwave radiation, male Fischer-344 rats were exposed to 900 mhz microwave radiation ($SAR = 5.953 \times 10^{-4}$ W/kg) and 1800 mhz microwave radiation ($SAR = 5.835 \times 10^{-4}$ W/kg) for 30 days (2 h/day). Significant impairment in cognitive function and induction of oxidative stress in brain tissues of microwave exposed rats were observed in comparison with sham exposed groups. Further, significant increase in level of cytokines (IL-6 and TNF- α) was also observed following microwave exposure. Results of the present study indicated that increased oxidative stress due to microwave exposure may contribute to cognitive impairment and inflammation in brain."

Krause, C., Björnberg, C., Pesonen, M., Hultén, A., Liesivuori, T., Koivisto, M., ... Hämäläinen, H.. (2006). Mobile phone effects on children's event-related oscillatory EEG during an auditory memory task. *International Journal of Radiation Biology*

Plain numerical DOI: 10.1080/09553000600840922

[DOI URL](#)

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"PURPOSE: to assess the effects of electromagnetic fields (EMF) emitted by mobile phones (MP) on



the 1 – 20 hz event-related brain oscillatory eeg (electroencephalogram) responses in children performing an auditory memory task (encoding and recognition). materials and methods: eeg data were gathered while 15 subjects (age 10 – 14 years) performed an auditory memory task both with and without exposure to a digital 902 mhz mp in counterbalanced order. results: during memory encoding, the active mp modulated the event-related desynchronization/synchronization (erd/ers) responses in the approximately 4 – 8 hz eeg frequencies. during recognition, the active mp transformed these brain oscillatory responses in the approximately 4 – 8 hz and approximately 15 hz frequencies. conclusions: the current findings suggest that emf emitted by mobile phones has effects on brain oscillatory responses during cognitive processing in children."

Mortazavi, S. A. R., Tavakkoli-Golpayegani, A., Haghani, M., & Mortazavi, S. M. J.. (2014).

Looking at the other side of the coin: The search for possible biopositive cognitive effects of the exposure to 900 MHz GSM mobile phone radiofrequency radiation. *Journal of Environmental Health Science and Engineering*

Plain numerical DOI: 10.1186/2052-336X-12-75

[DOI URL](#)

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"Although exposure to electromagnetic radiation in radiofrequency range has caused a great deal of concern globally, radiofrequency radiation has many critical applications in both telecommunication and non-communication fields. the induction of adaptive response phenomena by exposure to radiofrequency radiation as either increased resistance to a subsequent dose of ionizing radiation or resistance to a bacterial infection has been reported recently. interestingly, the potential beneficial effects of mobile phone radiofrequency radiation are not only limited to the induction of adaptive phenomena. it has previously been indicated that the visual reaction time of university students significantly decreased after a 10 min exposure to radiofrequency radiation emitted by a mobile phone. furthermore, it has been revealed that occupational exposures to radar radiations decreased the reaction time in radar workers. based on these findings, it can be hypothesized that in special circumstances, these exposures might lead to a better response of humans to different hazards. other investigators have also provided evidence that confirms the induction of rf-induced cognitive benefits. furthermore, some recent reports have indicated that rf radiation may play a role in protecting against cognitive impairment in alzheimer's disease. in this light, a challenging issue will arise if there are other rf-induced stimulating effects. it is also challenging to explore the potential applications of these effects. further research may shed light on dark areas of the health effects of short and long-term human exposure to radiofrequency radiation."

Guo, J., Wang, X. W., Sheng, J., & Tang, J. T.. (2009). Biological effects of electromagnetic radiation on the nervous system. *Journal of Clinical Rehabilitative Tissue Engineering Research*

Plain numerical DOI: 10.3969/j.issn.1673-8225.2009.30.031

[DOI URL](#)

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"The effects of exposure to radiofrequency electromagnetic fields (emf), specifically related to the use



of mobile telephones, on the nervous system in humans have been the subject of a large number of experimental studies in recent years. there is some evidence of an effect of exposure to a global system for mobile telecommunication (gsm)-type signal on the spontaneous electroencephalogram (eeg). this is not corroborated, however, by the results from studies on evoked potentials. although there is some evidence emerging that there may be an effect of exposure to a gsm-type signal on sleep eeg, results are still variable. in summary, exposure to a gsm-type signal may result in minor effects on brain activity, but such changes have never been found to relate to any adverse health effects. no consistent significant effects on cognitive performance in adults have been observed. if anything, any effect is small and exposure seems to improve performance. effects in children did not differ from those in healthy adults. studies on auditory and vestibular function are more unequivocal: neither hearing nor the sense of balance is influenced by short-term exposure to mobile phone signals. subjective symptoms over a wide range, including headaches and migraine, fatigue, and skin itch, have been attributed to various radiofrequency sources both at home and at work. however, in provocation studies a causal relation between emf exposure and symptoms has never been demonstrated. there are clear indications, however, that psychological factors such as the conscious expectation of effect may play an important role in this condition."

Tang, J., Zhang, Y., Yang, L., Chen, Q., Tan, L., Zuo, S., ... Zhu, G.. (2015). Exposure to 900 MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats. Brain Research

Plain numerical DOI: 10.1016/j.brainres.2015.01.019

[DOI URL](#)

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"Abstract with the rapid increase in the number of mobile phone users, the potential adverse effects of the electromagnetic field radiation emitted by a mobile phone has become a serious concern. this study demonstrated, for the first time, the blood-brain barrier and cognitive changes in rats exposed to 900 mhz electromagnetic field (emf) and aims to elucidate the potential molecular pathway underlying these changes. a total of 108 male sprague-dawley rats were exposed to a 900 mhz, 1 mw/cm²emf or sham (unexposed) for 14 or 28 days (3 h per day). the specific energy absorption rate (sar) varied between 0.016 (whole body) and 2 w/kg (locally in the head). in addition, the morris water maze test was used to examine spatial memory performance determination. morphological changes were investigated by examining ultrastructural changes in the hippocampus and cortex, and the evans blue assay was used to assess blood brain barrier (bbb) damage. immunostaining was performed to identify heme oxygenase-1 (ho-1)-positive neurons and albumin extravasation detection. western blot was used to determine ho-1 expression, phosphorylated erk expression and the upstream mediator, mkp-1 expression. we found that the frequency of crossing platforms and the percentage of time spent in the target quadrant were lower in rats exposed to emf for 28 days than in rats exposed to emf for 14 days and unexposed rats. moreover, 28 days of emf exposure induced cellular edema and neuronal cell organelle degeneration in the rat. in addition, damaged bbb permeability, which resulted in albumin and ho-1 extravasation were observed in the hippocampus and cortex. thus, for the first time, we found that emf exposure for 28 days induced the expression of mkp-1, resulting in erk dephosphorylation. taken together, these results demonstrated that exposure to 900 mhz emf radiation for 28 days can significantly impair spatial memory and damage bbb permeability in rat by activating the mkp-1/erk



pathway."

Fragopoulou, A. F., Miltiadous, P., Stamatakis, A., Stylianopoulou, F., Koussoulakos, S. L., & Margaritis, L. H.. (2010). Whole body exposure with GSM 900MHz affects spatial memory in mice. *Pathophysiology*

Plain numerical DOI: 10.1016/j.pathophys.2009.11.002

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"Extended work has been performed worldwide on the effects of mobile phone radiation upon rats' cognitive functions, however there is great controversy to the existence or not of deficits. the present work has been designed in order to test the effects of mobile phone radiation on spatial learning and memory in mice mus musculus balb/c using the morris water maze (a hippocampal-dependent spatial memory task), since there is just one other study on mice with very low sar level (0.05. w/kg) showing no effects. we have applied a 2. h daily dose of pulsed gsm 900. mhz radiation from commercially available mobile phone for 4 days at sar values ranging from 0.41 to 0.98. w/kg. statistical analysis revealed that during learning, exposed animals showed a deficit in transferring the acquired spatial information across training days (increased escape latency and distance swam, compared to the sham-exposed animals, on the first trial of training days 2-4). moreover, during the memory probe-trial sham-exposed animals showed the expected preference for the target quadrant, while the exposed animals showed no preference, indicating that the exposed mice had deficits in consolidation and/or retrieval of the learned spatial information. our results provide a basis for more thorough investigations considering reports on non-thermal effects of electromagnetic fields (emfs). © 2009 elsevier ireland ltd."

Schoeni, A., Roser, K., & Rösli, M.. (2015). Memory performance, wireless communication and exposure to radiofrequency electromagnetic fields: A prospective cohort study in adolescents. *Environment International*

Plain numerical DOI: 10.1016/j.envint.2015.09.025

[DOI URL](#)

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"Background: the aim of this study is to investigate whether memory performance in adolescents is affected by radiofrequency electromagnetic fields (rf-emf) from wireless device use or by the wireless device use itself due to non-radiation related factors in that context. methods: we conducted a prospective cohort study with 439 adolescents. verbal and figural memory tasks at baseline and after one year were completed using a standardized, computerized cognitive test battery. use of wireless devices was inquired by questionnaire and operator recorded mobile phone use data was obtained for a subgroup of 234 adolescents. rf-emf dose measures considering various factors affecting rf-emf exposure were computed for the brain and the whole body. data were analysed using a longitudinal approach, to investigate whether cumulative exposure over one year was related to changes in memory performance. all analyses were adjusted for relevant confounders. results: the kappa coefficients between cumulative mobile phone call duration and rf-emf brain and whole body dose were 0.62 and 0.67, respectively for the whole sample and 0.48 and 0.28, respectively for the sample with



operator data. in linear exposure-response models an interquartile increase in cumulative operator recorded mobile phone call duration was associated with a decrease in figural memory performance score by 0.15 (95% ci: 0.33, 0.03) units. for cumulative rf-emf brain and whole body dose corresponding decreases in figural memory scores were 0.26 (95% ci: 0.42, 0.10) and 0.40 (95% ci: 0.79, 0.01), respectively. no exposure-response associations were observed for sending text messages and duration of gaming, which produces tiny rf-emf emissions. conclusions: a change in memory performance over one year was negatively associated with cumulative duration of wireless phone use and more strongly with rf-emf dose. this may indicate that rf-emf exposure affects memory performance."

Gursatej Gandhi, A.. (2005). Genetic damage in mobile phone users: some preliminary findings. Indian Journal of Human Genetics

Plain numerical DOI: 10.4103/0971-6866.16810

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"BACKGROUND : the impact of microwave (mw)/radio frequency radiation (rfr) on important biological parameters is probably more than a simply thermal one. exposure to radio frequency (rf) signals generated by the use of cellular telephones have increased dramatically and reported to affect physiological, neurological, cognitive and behavioural changes and to induce, initiate and promote carcinogenesis. genotoxicity of rfr has also been reported in various test systems after in vitro and/or in vivo exposure but none in mobile phone users. aims : in the present study, dna and chromosomal damage investigations were carried out on the peripheral blood lymphocytes of individuals using mobile phones, being exposed to mw frequency ranging from 800 to 2000 mhz. methods : dna damage was assessed using the single cell gel electrophoresis assay and aneugenic and clastogenic damage by the in vivo capillary blood micronucleus test (mnt) in a total of 24 mobile phone users. results : mean comet tail length (26.76 ± 0.054 ?m; 39.75% of cells damaged) in mobile phone users was highly significant from that in the control group. the in vivo capillary blood mnt also revealed highly significant (0.25) frequency of micronucleated (mnd) cells. conclusions : these results highlight a correlation between mobile phone use (exposure to rfr) and genetic damage and require interim public health actions in the wake of widespread use of mobile telephony."

Caraglia, M., Marra, M., Mancinelli, F., D'Ambrosio, G., Massa, R., Giordano, A., ... Bismuto, E.. (2005). Electromagnetic fields at mobile phone frequency induce apoptosis and inactivation of the multi-chaperone complex in human epidermoid cancer cells. Journal of Cellular Physiology

Plain numerical DOI: 10.1002/jcp.20327

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"The exposure to non-thermal microwave electromagnetic field (mw-emf) at 1.95 mhz, a frequency used in mobile communication, affects the refolding kinetics of eukaryotic proteins (mancinelli et al., 2004). on these basis we have evaluated the in vivo effect of mw-emf in human epidermoid cancer kb cells. we have found that mw-emf induces time-dependent apoptosis (45% after 3 h) that is paralleled



by an about 2.5-fold decrease of the expression of ras and raf-1 and of the activity of ras and erk-1/2. although also the expression of akt was reduced its activity was unchanged likely as a consequence of the increased expression of its upstream activator pi3k. in the same experimental conditions an about 2.5-fold increase of the ubiquitination of ras and raf-1 was also found and the addition for 12 h of proteasome inhibitor lactacystin at 10 μ M caused an accumulation of the ubiquitinated isoforms of ras and raf-1 and counteracted the effects of mw-emf on ras and raf-1 expression suggesting an increased proteasome-dependent degradation induced by mw-emf. the exposure of kb cells to mw-emf induced a differential activation of stress-dependent pathway with an increase of jnk-1 activity and hsp70 and 27 expression and with a reduction of p38 kinase activity and hsp90 expression. the overexpression of hsp90 induced by transfection of kb cells with a plasmid encoding for the factor completely antagonized the apoptosis and the inactivation of the ras \rightarrow erk-dependent survival signal induced by mw-emf. conversely, the inhibition of erk activity induced by 12 h exposure to 10 μ M mek-1 inhibitor uo126 antagonized the effects induced by hsp90 transfection on apoptosis caused by mw-emf. in conclusion, these results demonstrate for the first time that mw-emf induces apoptosis through the inactivation of the ras, erk survival signaling due to enhanced degradation of ras and raf-1 determined by decreased expression of hsp90 and the consequent increase of proteasome dependent degradation. *J. Cell. Physiol.* 204: 539-548, 2005. (c) 2005 Wiley-Liss, Inc."

Shahin, S., Mishra, V., Singh, S. P., & Chaturvedi, C. M.. (2014). 2.45-GHz microwave irradiation adversely affects reproductive function in male mouse, *Mus musculus* by inducing oxidative and nitrosative stress. *Free Radical Research*

Plain numerical DOI: 10.3109/10715762.2014.888717

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"Electromagnetic radiations are reported to produce long-term and short-term biological effects, which are of great concern to human health due to increasing use of devices emitting emr especially microwave (mw) radiation in our daily life. in view of the unavoidable use of mw emitting devices (microwaves oven, mobile phones, wi-fi, etc.) and their harmful effects on biological system, it was thought worthwhile to investigate the long-term effects of low-level mw irradiation on the reproductive function of male swiss strain mice and its mechanism of action. twelve-week-old mice were exposed to non-thermal low-level 2.45-ghz mw radiation (cw for 2 h/day for 30 days, power density = 0.029812 mw/cm(2) and sar = 0.018 w/kg). sperm count and sperm viability test were done as well as vital organs were processed to study different stress parameters. plasma was used for testosterone and testis for 3 β hsd assay. immunohistochemistry of 3 β hsd and nitric oxide synthase (i-nos) was also performed in testis. we observed that mw irradiation induced a significant decrease in sperm count and sperm viability along with the decrease in seminiferous tubule diameter and degeneration of seminiferous tubules. reduction in testicular 3 β hsd activity and plasma testosterone levels was also noted in the exposed group of mice. increased expression of testicular i-nos was observed in the mw-irradiated group of mice. further, these adverse reproductive effects suggest that chronic exposure to nonionizing mw radiation may lead to infertility via free radical species-mediated pathway."

Ertilav, K., Uslusoy, F., Ataizi, S., & Nazaroğlu, M.. (2018). Long term exposure to cell phone frequencies (900 and 1800 MHz) induces apoptosis, mitochondrial oxidative stress and TRPV1 channel activation in the hippocampus and dorsal root ganglion of rats. *Metabolic Brain Disease*

Plain numerical DOI: 10.1007/s11011-017-0180-4

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"Mobile phone providers use electromagnetic radiation (emr) with frequencies ranging from 900 to 1800 mhz. the increasing use of mobile phones has been accompanied by several potentially pathological consequences, such as neurological diseases related to hippocampal (hippon) and dorsal root ganglion neuron (drgn). the trpv1 channel is activated different stimuli, including capn, high temperature and oxidative stress. we investigated the contribution trpv1 to mitochondrial oxidative stress and apoptosis in hippon and drgn following long term exposure to 900 and 1800 mhz in a rat model. twenty-four adult rats were equally divided into the following groups: (1) control, (2) 900 mhz, and (3) 1800 mhz exposure. each experimental group was exposed to emr for 60 min/ 5 days of the week during the one year. the 900 and 1800 mhz emr exposure induced increases in trpv1 currents, intracellular free calcium influx ($ca(2+)$), reactive oxygen species (ros) production, mitochondrial membrane depolarization (jc-1), apoptosis, and caspase 3 and 9 activities in the hippon and drgn. these deleterious processes were further increased in the 1800 mhz experimental group compared to the 900 mhz exposure group. in conclusion, mitochondrial oxidative stress, programmed cell death and $ca(2+)$ entry pathway through trpv1 activation in the hippon and drgn of rats were increased in the rat model following exposure to 900 and 1800 mhz cell frequencies. our results suggest that exposure to 900 and 1800 mhz emr may induce a dose-associated, trpv1-mediated stress response."

Diem, E., Schwarz, C., Adlkofer, F., Jahn, O., & Rüdiger, H.. (2005). Non-thermal DNA breakage by mobile-phone radiation (1800 MHz) in human fibroblasts and in transformed GFSH-R17 rat granulosa cells in vitro. Mutation Research – Genetic Toxicology and Environmental Mutagenesis

Plain numerical DOI: 10.1016/j.mrgentox.2005.03.006

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"Cultured human diploid fibroblasts and cultured rat granulosa cells were exposed to intermittent and continuous radiofrequency electromagnetic fields (rf-emf) used in mobile phones, with different specific absorption rates (sar) and different mobile-phone modulations. dna strand breaks were determined by means of the alkaline and neutral comet assay. rf-emf exposure (1800 mhz; sar 1.2 or 2 w/kg; different modulations; during 4, 16 and 24 h; intermittent 5 min on/10 min off or continuous wave) induced dna single- and double-strand breaks. effects occurred after 16 h exposure in both cell types and after different mobile-phone modulations. the intermittent exposure showed a stronger effect in the comet assay than continuous exposure. therefore we conclude that the induced dna damage cannot be based on thermal effects. © 2005 elsevier b.v. all rights reserved."

De Iuliis, G. N., Newey, R. J., King, B. V., & Aitken, R. J.. (2009). Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro. PLoS ONE

Plain numerical DOI: 10.1371/journal.pone.0006446

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"Background In recent times there has been some controversy over the impact of electromagnetic radiation on human health. the significance of mobile phone radiation on male reproduction is a key element of this debate since several studies have suggested a relationship between mobile phone use and semen quality. the potential mechanisms involved have not been established, however, human spermatozoa are known to be particularly vulnerable to oxidative stress by virtue of the abundant availability of substrates for free radical attack and the lack of cytoplasmic space to accommodate antioxidant enzymes. moreover, the induction of oxidative stress in these cells not only perturbs their capacity for fertilization but also contributes to sperm dna damage. the latter has, in turn, been linked with poor fertility, an increased incidence of miscarriage and morbidity in the offspring, including childhood cancer. in light of these associations, we have analyzed the influence of rf-emr on the cell biology of human spermatozoa in vitro. principal findings purified human spermatozoa were exposed to radio-frequency electromagnetic radiation (rf-emr) tuned to 1.8 ghz and covering a range of specific absorption rates (sar) from 0.4 w/kg to 27.5 w/kg. in step with increasing sar, motility and vitality were significantly reduced after rf-emr exposure, while the mitochondrial generation of reactive oxygen species and dna fragmentation were significantly elevated (p"

Leszczynski, D., Joenväärä, S., Reivinen, J., & Kuokka, R.. (2002). Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: Molecular mechanism for cancer- and blood-brain barrier-related effects. Differentiation

Plain numerical DOI: 10.1046/j.1432-0436.2002.700207.x

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"We have examined whether non-thermal exposures of cultures of the human endothelial cell line ea.hy926 to 900 mhz gsm mobile phone microwave radiation could activate stress response. results obtained demonstrate that 1-hour non-thermal exposure of ea.hy926 cells changes the phosphorylation status of numerous, yet largely unidentified, proteins. one of the affected proteins was identified as heat shock protein-27 (hsp27). mobile phone exposure caused a transient increase in phosphorylation of hsp27, an effect which was prevented by sb203580, a specific inhibitor of p38 mitogen-activated protein kinase (p38mapk). also, mobile phone exposure caused transient changes in the protein expression levels of hsp27 and p38mapk. all these changes were non-thermal effects because, as determined using temperature probes, irradiation did not alter the temperature of cell cultures, which remained throughout the irradiation period at 37 +/- 0.3 degrees c. changes in the overall pattern of protein phosphorylation suggest that mobile phone radiation activates a variety of cellular signal transduction pathways, among them the hsp27/p38mapk stress response pathway. based on the known functions of hsp27, we put forward the hypothesis that mobile phone radiation-induced activation of hsp27 may (i) facilitate the development of brain cancer by inhibiting the cytochrome c/caspase-3 apoptotic pathway and (ii) cause an increase in blood-brain barrier permeability through stabilization of endothelial cell stress fibers. we postulate that these events, when occurring repeatedly over a long period of time, might become a health hazard because of the possible accumulation of brain tissue damage. furthermore, our hypothesis suggests that other brain damaging



factors may co-participate in mobile phone radiation-induced effects."

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Kesari, K. K., Meena, R., Nirala, J., Kumar, J., & Verma, H. N.. (2014). Effect of 3G Cell Phone Exposure with Computer Controlled 2-D Stepper Motor on Non-thermal Activation of the hsp27/p38MAPK Stress Pathway in Rat Brain. Cell Biochemistry and Biophysics

Plain numerical DOI: 10.1007/s12013-013-9715-4

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"Cell phone radiation exposure and its biological interaction is the present concern of debate. present study aimed to investigate the effect of 3g cell phone exposure with computer controlled 2-d stepper motor on 45-day-old male wistar rat brain. animals were exposed for 2 h a day for 60 days by using mobile phone with angular movement up to zero to 30°. the variation of the motor is restricted to 90° with respect to the horizontal plane, moving at a pre-determined rate of 2° per minute. immediately after 60 days of exposure, animals were scarified and numbers of parameters (dna double-strand break, micronuclei, caspase 3, apoptosis, dna fragmentation, expression of stress-responsive genes)



were performed. result shows that microwave radiation emitted from 3g mobile phone significantly induced dna strand breaks in brain. meanwhile a significant increase in micronuclei, caspase 3 and apoptosis were also observed in exposed group ($p < 0.05$). western blotting result shows that 3g mobile phone exposure causes a transient increase in phosphorylation of hsp27, hsp70, and p38 mitogen-activated protein kinase (p38mapk), which leads to mitochondrial dysfunction-mediated cytochrome c release and subsequent activation of caspases, involved in the process of radiation-induced apoptotic cell death. study shows that the oxidative stress is the main factor which activates a variety of cellular signal transduction pathways, among them the hsp27/p38mapk is the pathway of principle stress response. results conclude that 3g mobile phone radiations affect the brain function and cause several neurological disorders."

Kesari, K. K., Siddiqui, M. H., Meena, R., Verma, H. N., & Kumar, S.. (2013). Cell phone radiation exposure on brain and associated biological systems. *Indian Journal of Experimental Biology*

Plain numerical DOI: 10.1016/j.biopha.2007.12.004

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"Wireless technologies are ubiquitous today and the mobile phones are one of the prodigious output of this technology. although the familiarization and dependency of mobile phones is growing at an alarming pace, the biological effects due to the exposure of radiations have become a subject of intense debate. the present evidence on mobile phone radiation exposure is based on scientific research and public policy initiative to give an overview of what is known of biological effects that occur at radiofrequency (rf)/ electromagnetic fields (emfs) exposure. the conflict in conclusions is mainly because of difficulty in controlling the affecting parameters. biological effects are dependent not only on the distance and size of the object (with respect to the object) but also on the environmental parameters. health endpoints reported to be associated with rf include childhood leukemia, brain tumors, genotoxic effects, neurological effects and neurodegenerative diseases, immune system deregulation, allergic and inflammatory responses, infertility and some cardiovascular effects. most of the reports conclude a reasonable suspicion of mobile phone risk that exists based on clear evidence of bio-effects which with prolonged exposures may reasonably be presumed to result in health impacts. the present study summarizes the public issue based on mobile phone radiation exposure and their biological effects. this review concludes that the regular and long term use of microwave devices (mobile phone, microwave oven) at domestic level can have negative impact upon biological system especially on brain. it also suggests that increased reactive oxygen species (ros) play an important role by enhancing the effect of microwave radiations which may cause neurodegenerative diseases."

Lai, H., & Hardell, L.. (2011). Cell phone radiofrequency radiation exposure and brain glucose metabolism. *JAMA – Journal of the American Medical Association*

Plain numerical DOI: 10.1001/jama.2011.201

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"The majority of the radiofrequency energy emitted by a cellular telephone is absorbed by the hand and



head of the user. in addition to concerns about potential harmful effects of such exposure, such as the issue of risk of brain cancer, change in brain function related to cellphone radiofrequencies also is of concern. here, lai and hardell comment on the study by volkow and colleagues investigating humans of glucose metabolism in the brain after cell phone use. results indicated that the cell phone was actually emitting less radiofrequency radiation than is the case when a user is speaking into a phone, and the effect observed could thus potentially be more pronounced in normal-use situations. they point out that these results add to the concern about possible acute and long-term health effects of radiofrequency emissions from wireless phones, including both mobile and cordless desktop phones. although the biological significance, if any, of increased glucose metabolism from acute cell phone exposure is unknown, the results warrant further investigation."

Aly, A. A., Deris, S. Bin, & Zaki, N.. (2008). Research review on the biological effect of cell phone radiation on human. In 2008 International Conference on Innovations in Information Technology, IIT 2008

Plain numerical DOI: 10.1109/INNOVATIONS.2008.4781774

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"The growth in the use of cellular phone has raised the concerns about the possible interaction between the electromagnetic fields (emf) radiation and the biological effects on human tissues, particularly the brain and the human immune system. these concerns have induced a large volume of research studies. however, most of the previous review studies are concentrated on negative effects and no published work took in consideration all possible effects caused by the use of cell phones. in this paper we aim to provide review of some studies which investigated the possible negative and positive biological effects of cell phone radiation on human tissues. this review will provide answers for public concerns about the risk of using cell phone. our conclusion shows that long-term exposure to emf radiation from a cell phone could cause health effects, such as brain cancer. some positive health effects due to the exposure to the emf radiation such as improve bone healing and reduce toxic effects of chemotherapy are highlighted. finally, some studies have also showed no effect due to exposure to emf. more long-term studies and analysis are much needed."

Yakymenko, I., & Sidorik, E.. (2010). Risks of carcinogenesis from electromagnetic radiation of mobile telephony devices. Experimental Oncology

Plain numerical DOI: 45/835 [pii]

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"Intensive implementation of mobile telephony technology in everyday human life during last two decades has given a possibility for epidemiological estimation of long-term effects of chronic exposure of human organism to low-intensive microwave (mw) radiation. latest epidemiological data reveal a significant increase in risk of development of some types of tumors in chronic (over 10 years) users of mobile phone. it was detected a significant increase in incidence of brain tumors (glioma, acoustic neuroma, meningioma), parotid gland tumor, seminoma in long-term users of mobile phone, especially



in cases of ipsilateral use (case-control odds ratios from 1.3 up to 6.1). two epidemiological studies have indicated a significant increase of cancer incidence in people living close to the mobile telephony base station as compared with the population from distant area. these data raise a question of adequacy of modern safety limits of electromagnetic radiation (emr) exposure for humans. for today the limits were based solely on the conception of thermal mechanism of biological effects of rf/mw radiation. meantime the latest experimental data indicate the significant metabolic changes in living cell under the low-intensive (non-thermal) emr exposure. among reproducible biological effects of low-intensive mws are reactive oxygen species overproduction, heat shock proteins expression, dna damages, apoptosis. the lack of generally accepted mechanism of biological effects of low-intensive non-ionizing radiation doesn't permit to disregard the obvious epidemiological and experimental data of its biological activity. practical steps must be done for reasonable limitation of excessive emr exposure, along with the implementation of new safety limits of mobile telephony devices radiation, and new technological decisions, which would take out the source of radiation from human brain. key words: tumor, radiofrequency radiation, microwaves, mobile phone, risk assessment, non-thermal effects." Hossmann, K. A., & Hermann, D. M.. (2003). Effects of Electromagnetic Radiation of Mobile Phones on the Central Nervous System. Bioelectromagnetics

Plain numerical DOI: 10.1002/bem.10068

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"With the increasing use of mobile communication, concerns have been expressed about the possible interactions of electromagnetic radiation with the human organism and, in particular, the brain. the effects on neuronal electrical activity, energy metabolism, genomic responses, neurotransmitter balance, blood-brain barrier permeability, cognitive function, sleep, and various brain diseases including brain tumors are reviewed. most of the reported effects are small as long as the radiation intensity remains in the nonthermal range, and none of the research reviewed gives an indication of the mechanisms involved at this range. however, health risks may evolve from indirect consequences of mobile telephony, such as the sharply increased incidence rate of traffic accidents caused by telephony during driving, and possibly also by stress reactions which annoyed bystanders may experience when cellular phones are used in public places. these indirect health effects presumably outweigh the direct biological perturbations and should be investigated in more detail in the future." Panagopoulos, D. J., Chavdoula, E. D., Nezis, I. P., & Margaritis, L. H.. (2007). Cell death induced by GSM 900-MHz and DCS 1800-MHz mobile telephony radiation. Mutation Research – Genetic Toxicology and Environmental Mutagenesis

Plain numerical DOI: 10.1016/j.mrgentox.2006.08.008

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"In the present study, the tunel (terminal deoxynucleotide transferase dutp nick end labeling) assay – a well known technique widely used for detecting fragmented dna in various types of cells – was used to detect cell death (dna fragmentation) in a biological model, the early and mid stages of oogenesis of



the insect *drosophila melanogaster*. the flies were exposed in vivo to either gsm 900-mhz (global system for mobile telecommunications) or dcs 1800-mhz (digital cellular system) radiation from a common digital mobile phone, for few minutes per day during the first 6 days of their adult life. the exposure conditions were similar to those to which a mobile phone user is exposed, and were determined according to previous studies of ours [d.j. panagopoulos, a. karabarounis, l.h. margaritis, effect of gsm 900-mhz mobile phone radiation on the reproductive capacity of *d. melanogaster*, *electromagn. biol. med.* 23 (1) (2004) 29-43; d.j. panagopoulos, n. messini, a. karabarounis, a.l. philippetis, l.h. margaritis, radio frequency electromagnetic radiation within 'safety levels' alters the physiological function of insects, in: p. kostarakis, p. stavroulakis (eds.), *proceedings of the millennium international workshop on biological effects of electromagnetic fields*, heraklion, crete, greece, october 17-20, 2000, pp. 169-175, isbn: 960-86733-0-5; d.j. panagopoulos, l.h. margaritis, effects of electromagnetic fields on the reproductive capacity of *d. melanogaster*, in: p. stavroulakis (ed.), *biological effects of electromagnetic fields*, springer, 2003, pp. 545-578], which had shown a large decrease in the oviposition of the same insect caused by gsm radiation. our present results suggest that the decrease in oviposition previously reported, is due to degeneration of large numbers of egg chambers after dna fragmentation of their constituent cells, induced by both types of mobile telephony radiation. induced cell death is recorded for the first time, in all types of cells constituting an egg chamber (follicle cells, nurse cells and the oocyte) and in all stages of the early and mid-oogenesis, from germarium to stage 10, during which programmed cell death does not physiologically occur. germarium and stages 7-8 were found to be the most sensitive developmental stages also in response to electromagnetic stress induced by the gsm and dcs fields and, moreover, germarium was found to be even more sensitive than stages 7-8. © 2006 elsevier b.v. all rights reserved."

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